FIG. 1

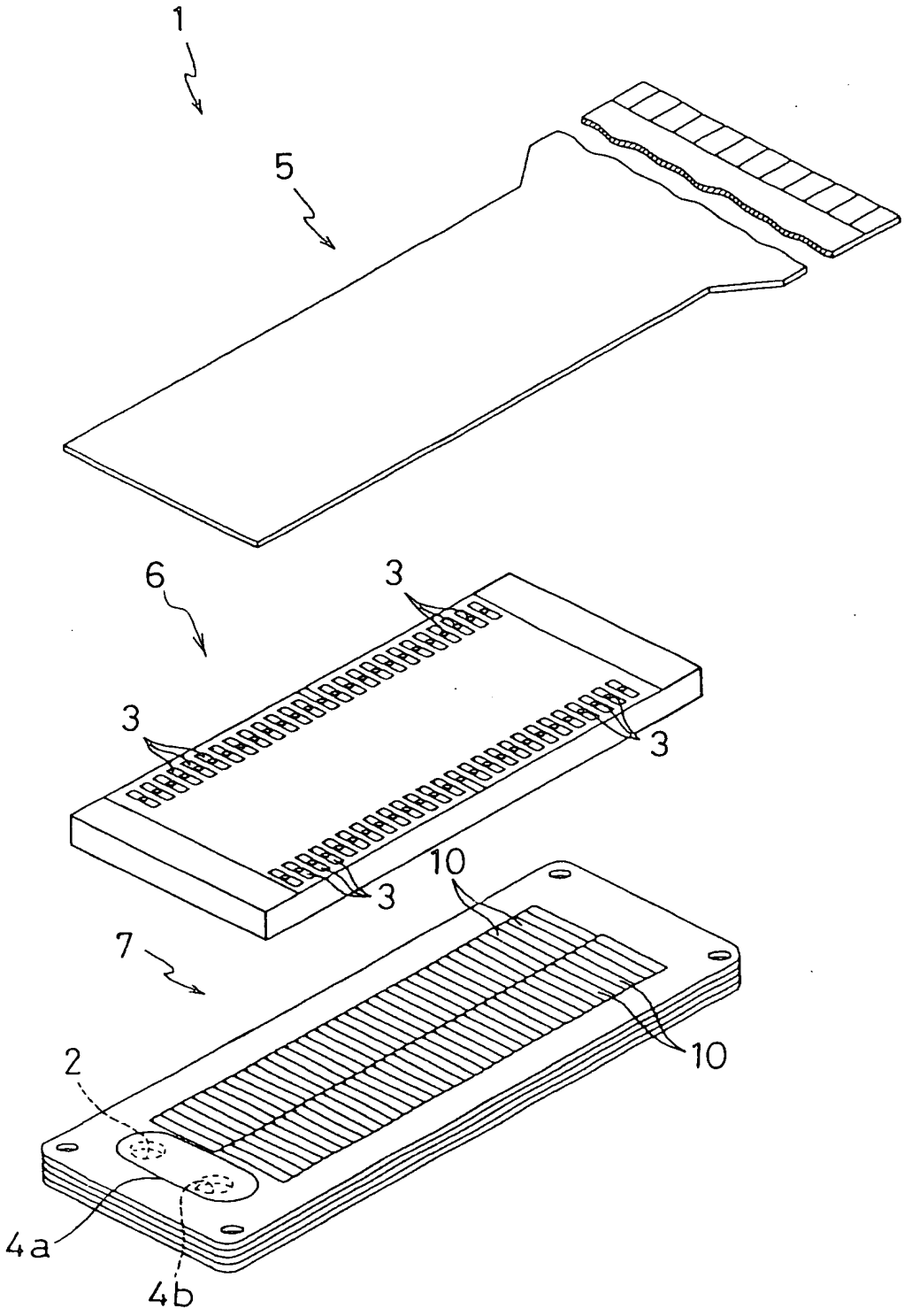

FIG. 2

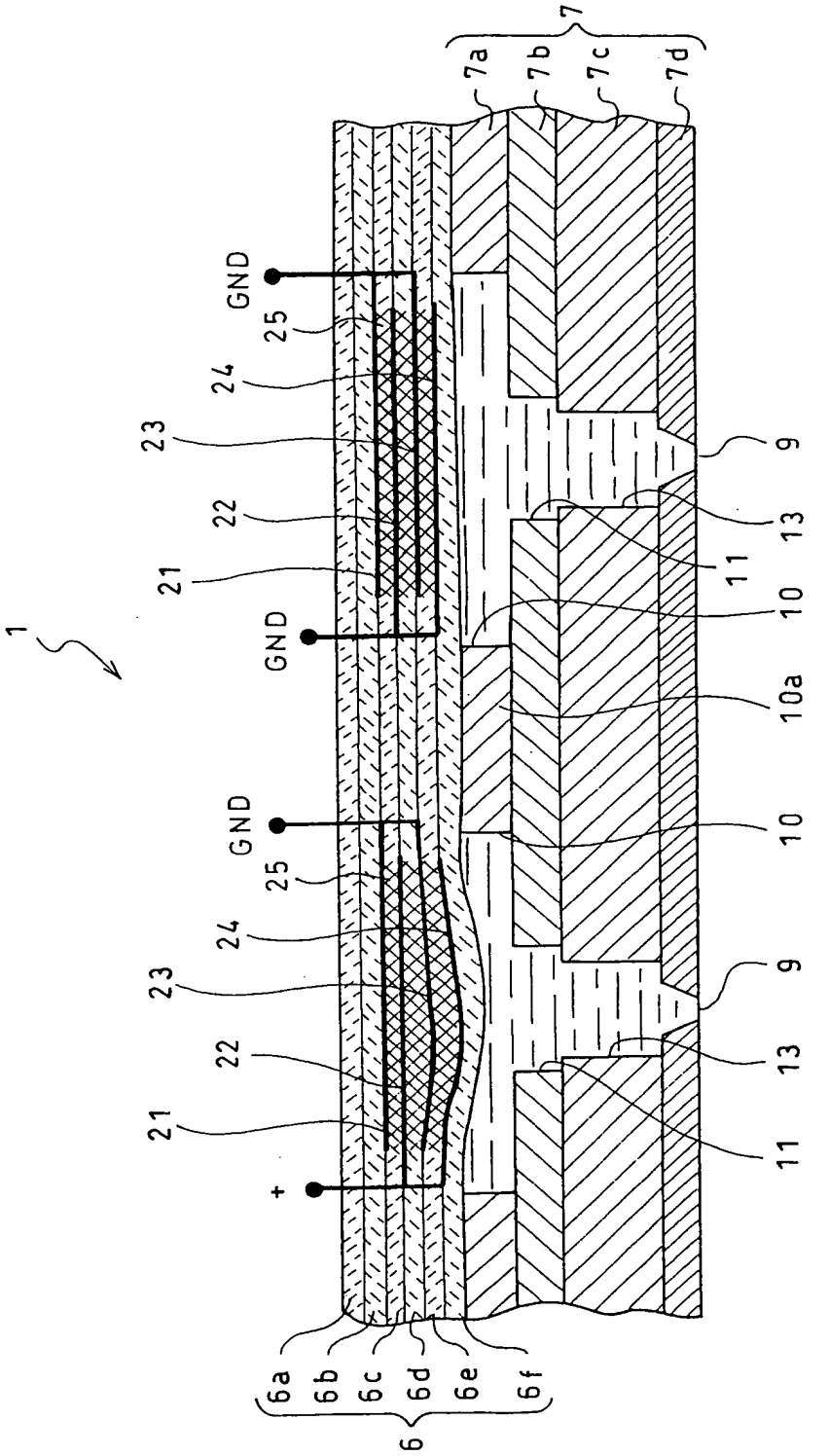
1
7
7a
7b
7c
7d
GND
25
24
23
22
21
GND
GND
25
24
23
22
21
+
9
13
11
10
10a
10
9
13
11
6a
6b
6c
6d
6e
6f
6

FIG. 3

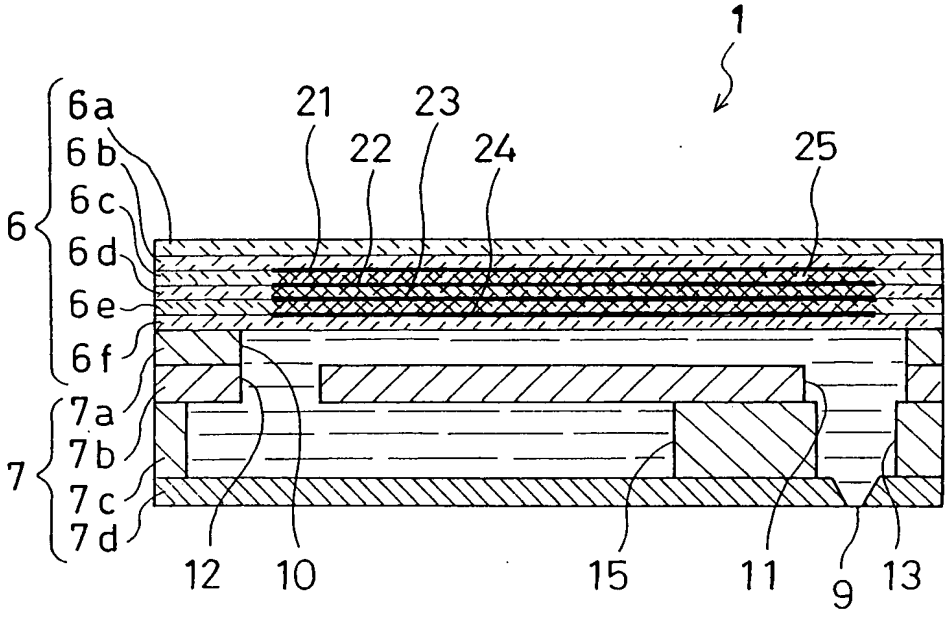

FIG.4

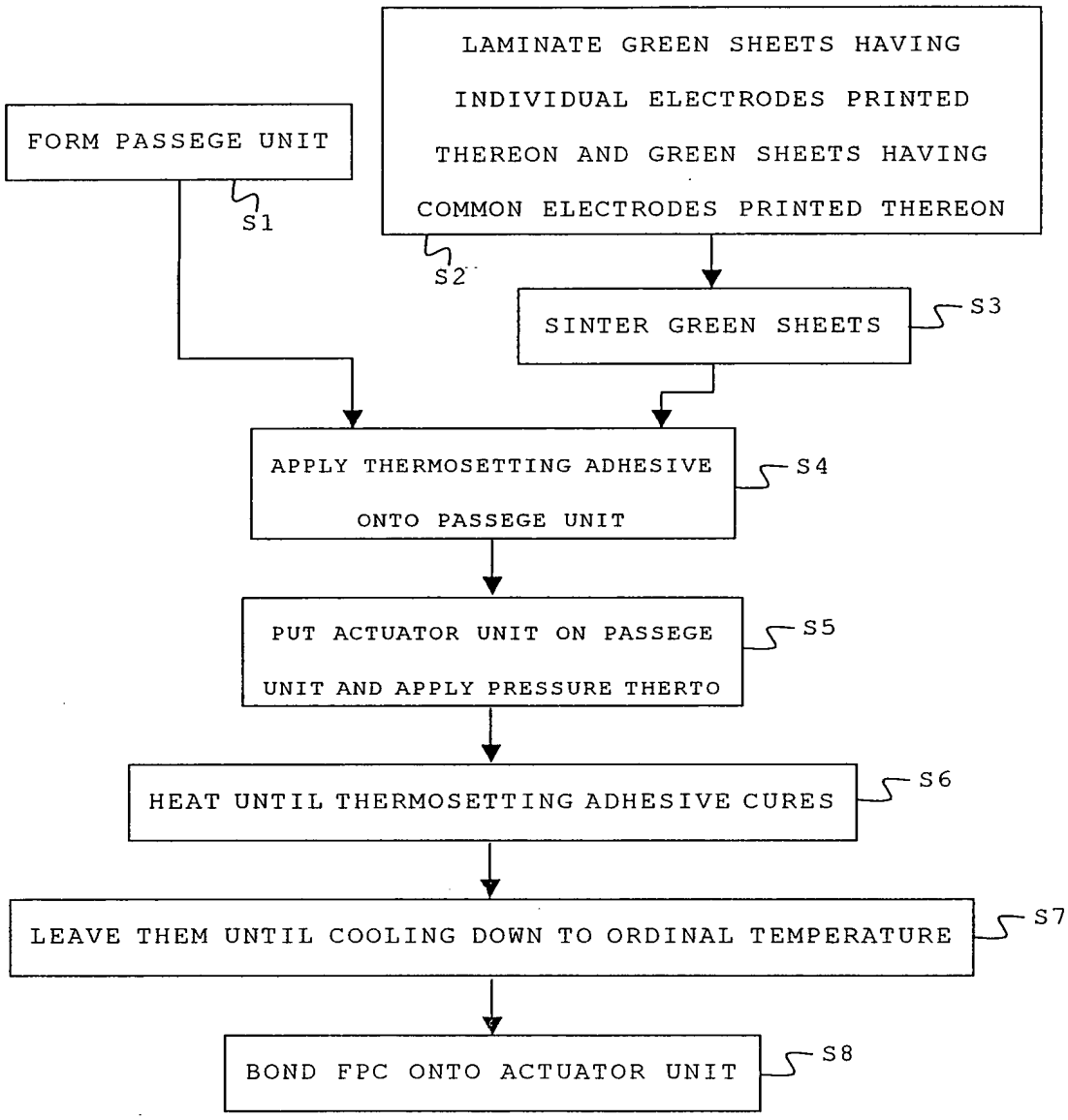
FORM PASSEGE UNIT
S1
LAMINATE GREEN SHEETS HAVING INDIVIDUAL ELECTRODES PRINTED THEREON AND GREEN SHEETS HAVING COMMON ELECTRODES PRINTED THEREON
S2
SINTER GREEN SHEETS
S3
APPLY THERMOSETTING ADHESIVE ONTO PASSEGE UNIT
S4
PUT ACTUATOR UNIT ON PASSEGE UNIT AND APPLY PRESSURE THERTO
S5
HEAT UNTIL THERMOSETTING ADHESIVE CURES
S6
LEAVE THEM UNTIL COOLING DOWN TO ORDINAL TEMPERATURE
S7
BOND FPC ONTO ACTUATOR UNIT
S8

FIG. 5A

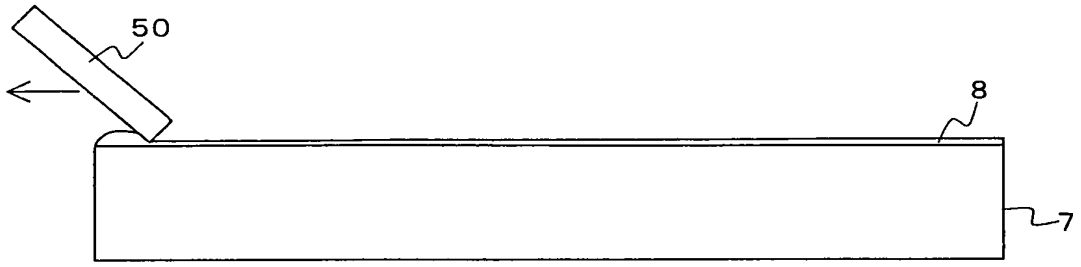

FIG. 5B

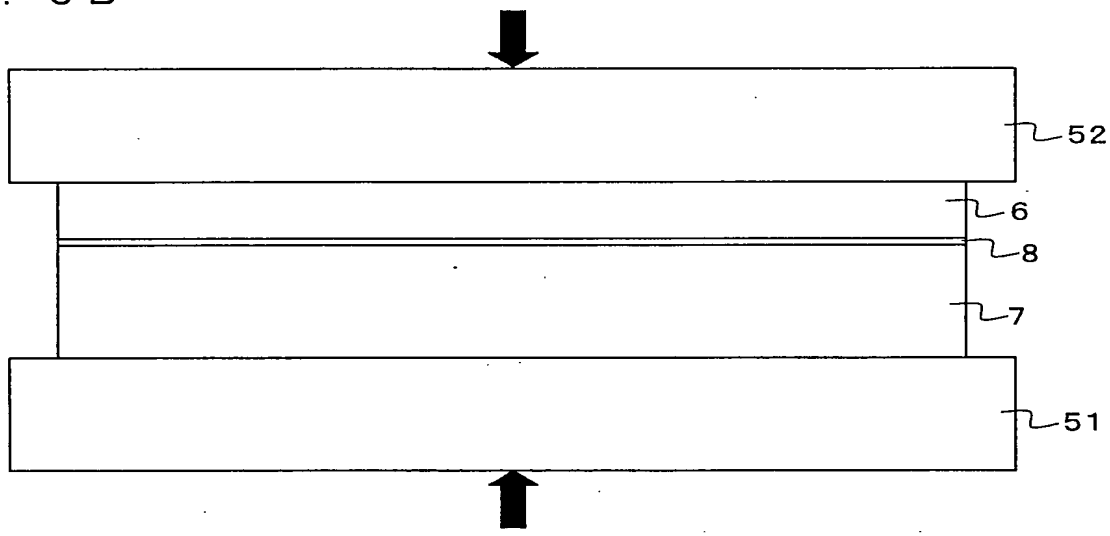

FIG. 5C

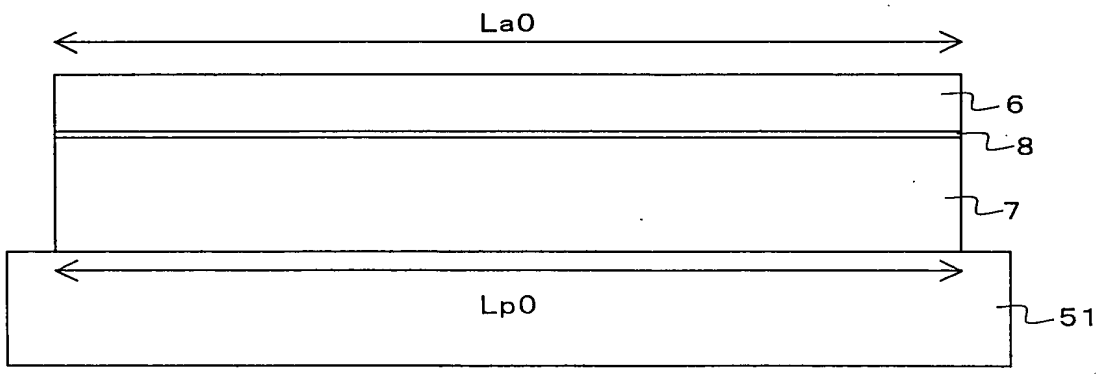

FIG. 5D

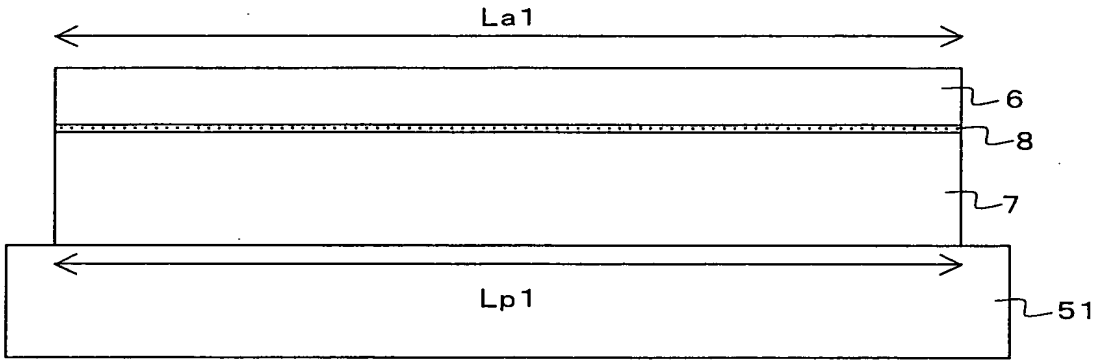

FIG. 5E

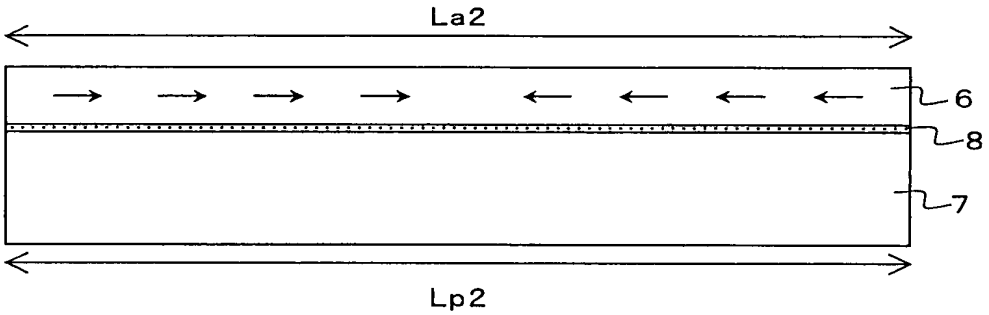

FIG. 6

Stress(MPa)	Capacitance(nF)	Voltage(V)
−50	0. 97	38
−40	1	28
−20	1. 05	24
0	1. 13	23
10	1. 2	22. 3
20	1. 32	22
40	1. 6	21. 5

FIG. 7A

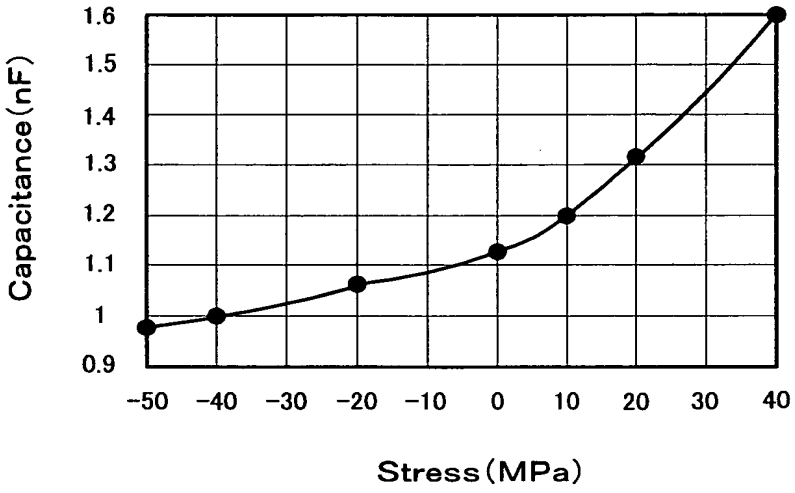
Capacitance(nF)
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
-50 -40 -30 -20 -10 0 10 20 30 40
Stress(MPa)

FIG. 7B

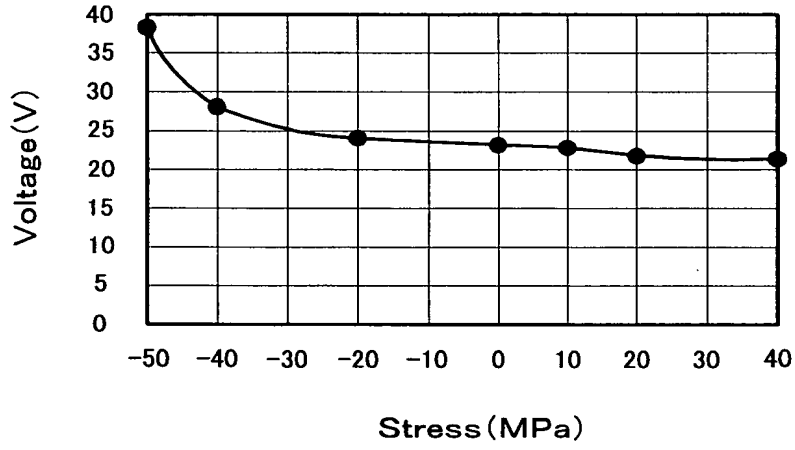
Voltage(V)
40
35
30
25
20
15
10
5
0
-50 -40 -30 -20 -10 0 10 20 30 40
Stress(MPa)

FIG. 8

DIFFERENCE IN LINEAR EXPANSION COEFFICIENT (ppm/°C)	HEATING TEMPERATURE (°C)																	
	30°C	40°C	50°C	60°C	70°C	80°C	90°C	100°C	110°C	120°C	130°C	140°C	150°C	160°C	170°C	180°C	190°C	200°C
-10.0	16.3	21.7	27.1	32.5	37.9	43.3	48.3	54.2	59.6	65.0	70.4	75.8	81.3	86.7	92.1	97.5	102.9	108.3
-9.0	14.6	19.5	24.4	29.3	34.1	39.0	43.9	48.8	53.6	58.5	63.4	68.3	73.1	78.0	82.9	87.8	92.6	97.5
-8.0	13.0	17.3	21.7	26.0	30.3	34.7	39.0	43.3	47.7	52.0	56.3	60.7	65.0	69.3	73.7	78.0	82.3	86.7
-7.0	11.4	15.2	19.0	22.8	26.5	30.3	34.1	37.9	41.7	45.5	49.3	53.1	56.9	60.7	64.5	68.3	72.0	75.8
-6.0	9.8	13.0	16.3	19.5	22.8	26.0	29.3	32.5	35.8	39.0	42.3	45.5	48.8	52.0	55.3	58.5	61.8	65.0
-5.0	8.1	10.8	13.5	16.3	19.0	21.7	24.4	27.1	29.8	32.5	35.2	37.9	40.6	43.3	46.0	48.8	51.5	54.2
-4.0	6.5	8.7	10.8	13.0	15.2	17.3	19.5	21.7	23.8	26.0	28.2	30.3	32.5	34.7	36.8	39.0	41.2	43.3
-3.0	4.9	6.5	8.1	9.8	11.4	13.0	14.6	16.3	17.9	19.5	21.1	22.8	24.4	26.0	27.6	29.3	30.9	32.5
-2.0	3.3	4.3	5.4	6.5	7.6	8.7	9.8	10.8	11.9	13.0	14.1	15.2	16.3	17.3	18.4	19.5	20.6	21.7
-1.0	1.6	2.2	2.7	3.3	3.8	4.3	4.9	5.4	6.0	6.5	7.0	7.6	8.1	8.7	9.2	9.8	10.3	10.8
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.0	-1.6	-2.2	-2.7	-3.3	-3.8	-4.3	-4.9	-5.4	-6.0	-6.5	-7.0	-7.6	-8.1	-8.7	-9.2	-9.8	-10.3	-10.8
2.0	-3.3	-4.3	-5.4	-6.5	-7.6	-8.7	-9.8	-10.8	-11.9	-13.0	-14.1	-15.2	-16.3	-17.3	-18.4	-19.5	-20.6	-21.7
3.0	-4.9	-6.5	-8.1	-9.8	-11.4	-13.0	-14.6	-16.3	-17.9	-19.5	-21.1	-22.8	-24.4	-26.0	-27.6	-29.3	-30.9	-32.5
4.0	-6.5	-8.7	-10.8	-13.0	-15.2	-17.3	-19.5	-21.7	-23.8	-26.0	-28.2	-30.3	-32.5	-34.7	-36.8	-39.0	-41.2	-43.3
5.0	-8.1	-10.8	-13.5	-16.3	-19.0	-21.7	-24.4	-27.1	-29.8	-32.5	-35.2	-37.9	-40.6	-43.3	-46.0	-48.8	-51.5	-54.2
6.0	-9.8	-13.0	-16.3	-19.5	-22.8	-26.0	-29.3	-32.5	-35.8	-39.0	-42.3	-45.5	-48.8	-52.0	-55.3	-58.5	-61.8	-65.0
7.0	-11.4	-15.2	-19.0	-22.8	-26.5	-30.3	-34.1	-37.9	-41.7	-45.5	-49.3	-53.1	-56.9	-60.7	-64.5	-68.3	-72.0	-75.8
8.0	-13.0	-17.3	-21.7	-26.0	-30.3	-34.7	-39.0	-43.3	-47.7	-52.0	-56.3	-60.7	-65.0	-69.3	-73.7	-78.0	-82.3	-86.7
9.0	-14.6	-19.5	-24.4	-29.3	-34.1	-39.0	-43.9	-48.8	-53.6	-58.5	-63.4	-68.3	-73.1	-78.0	-82.9	-87.8	-92.6	-97.5
10.0	-16.3	-21.7	-27.1	-32.5	-37.9	-43.3	-48.8	-54.2	-59.6	-65.0	-70.4	-75.8	-81.3	-86.7	-92.1	-97.5	-102.9	-108.3
11.0	-17.9	-23.8	-29.8	-35.8	-41.7	-47.7	-53.6	-59.6	-65.5	-71.5	-77.5	-83.4	-89.4	-95.3	-101.3	-107.3	-113.2	-119.2
12.0	-19.5	-26.0	-32.5	-39.0	-45.5	-52.0	-58.5	-65.0	-71.5	-78.0	-84.5	-91.0	-97.5	-104.0	-110.5	-117.0	-123.5	-130.0
13.0	-21.1	-28.2	-35.2	-42.3	-49.3	-56.3	-63.4	-70.4	-77.5	-84.5	-91.5	-98.6	-105.6	-112.7	-119.7	-126.8	-133.8	-140.8
14.0	-22.8	-30.3	-37.9	-45.5	-53.1	-60.7	-68.3	-75.8	-83.4	-91.0	-98.6	-106.2	-113.8	-121.3	-128.9	-136.5	-144.1	-151.7
15.0	-24.4	-32.5	-40.6	-48.8	-56.9	-65.0	-73.1	-81.3	-89.4	-97.5	-105.6	-113.8	-121.9	-130.0	-138.1	-146.3	-154.4	-162.5
16.0	-26.0	-34.7	-43.3	-52.0	-60.7	-69.3	-78.0	-86.7	-95.3	-104.0	-112.7	-121.3	-130.0	-138.7	-147.3	-156.0	-164.7	-173.3
17.0	-27.6	-36.8	-46.0	-55.3	-64.5	-73.7	-82.9	-92.1	-101.3	-110.5	-119.7	-128.9	-138.1	-147.3	-156.5	-165.8	-175.0	-184.2
18.0	-29.3	-39.0	-48.8	-58.5	-68.3	-78.0	-87.8	-97.5	-107.3	-117.0	-126.8	-136.5	-146.3	-156.0	-165.8	-175.5	-185.3	-195.0
19.0	-30.9	-41.2	-51.5	-61.8	-72.0	-82.3	-92.6	-102.9	-113.2	-123.5	-133.8	-144.1	-154.4	-164.7	-175.0	-185.3	-195.5	-205.8
20.0	-32.5	-43.3	-54.2	-65.0	-75.8	-86.7	-97.5	-108.3	-119.2	-130.0	-140.8	-151.7	-162.5	-173.3	-184.2	-195.0	-205.8	-216.7
21.0	-34.1	-45.5	-56.9	-68.3	-79.6	-91.0	-102.4	-113.8	-125.1	-136.5	-147.9	-159.3	-170.6	-182.0	-193.4	-204.8	-216.1	-227.5
22.0	-35.8	-47.7	-59.6	-71.5	-83.4	-95.3	-107.3	-119.2	-131.1	-143.0	-154.9	-166.8	-178.8	-190.7	-202.6	-214.5	-226.4	-238.3
23.0	-37.4	-49.8	-62.3	-74.8	-87.2	-99.7	-112.1	-124.6	-137.0	-149.5	-162.0	-174.4	-186.9	-199.3	-211.8	-224.3	-236.7	-249.2
24.0	-39.0	-52.0	-65.0	-78.0	-91.0	-104.0	-117.0	-130.0	-143.0	-156.0	-169.0	-182.0	-195.0	-208.0	-221.0	-234.0	-247.0	-260.0
25.0	-40.6	-54.2	-67.7	-81.3	-94.8	-108.3	-121.9	-135.4	-149.0	-162.5	-176.0	-189.6	-203.1	-216.7	-230.2	-243.8	-257.3	-270.8
26.0	-42.3	-56.3	-70.4	-84.5	-98.6	-112.7	-126.8	-140.8	-154.9	-169.0	-183.1	-197.2	-211.3	-225.3	-239.4	-23.5	-267.6	-281.7

FIG. 9

x: DIFFERENCE IN LINEAR EXPANSION COEFFICIENT (ppm／℃)	MAXIMUM HEATING TEMPERATURE (℃)
$18<x\leqq24$	30
$14<x\leqq18$	40
$12<x\leqq14$	50
$10<x\leqq12$	60
$9<x\leqq10$	70
$8<x\leqq9$	80
$7<x\leqq8$	90
$6<x\leqq7$	100
$5<x\leqq6$	120
$4<x\leqq5$	140
$3<x\leqq4$	180
$-1<x\leqq3$	200
$-2<x\leqq-1$	180
$-3<x\leqq-2$	90
$-4<x\leqq-3$	60
$-5<x\leqq-4$	40
$-7<x\leqq-5$	30

FIG. 10

		LINEAR EXPANSION COEFFICIENT (ppm／℃)	DIFFERENCE IN LINEAR EXPANSION COEFFICIENT (ppm／℃)	HEATING TEMPERATURE (ppm／℃)
ACTUATOR UNIT	PZT	5	—	—
PASSAGE UNIT	SUS430	10. 4	5. 4	120 or less
	SUS304	17. 3	12. 3	50 or less
	42 ALLOY	4. 5	−0. 5	200 or less